ECGVM MEMO aen4

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
Westford, Massachusetts 01886
September 2, 2005

To: VLBI and GPS data analysts
From: Arthur Niell

Subject: SA01(suominet)-WES2/Westford (GSOS) pressure comparison for 2005 doy 208 (2005/07/27)

1. Summary

Based on looking at one day of meterological data from one site (Westford, Massachusetts), it is clear that surface met at all sites should go through some form of quality control before it is used. For two sets of surface meteorology data at the Haystack Observatory I found that:

a. GSOS (Westford met sensor system) time is in error by approximately +1.5 hours.
b. the mean of (Pressure GSOS (after time adjustment) – Pressure SA01) = 0.015 hPa when adjusted to the height of WES2; standard deviation = 0.20 hPa
c. the reported pressures for SA01 (and other Suominet sites) are adjusted from the position of the sensor to the height of the antenna using 0.1 hPa/m.
d. the reported times for suominet thirty-minute averages are the times at the beginning of the integration period, so the time tags are early by 15 minutes.
e. the pressure correction from SA01 to Westford Intersection of Axes is +3.2 hPa.

2. Objective

Compare pressure measurements after height correction from two sensors at Westford: the Suominet SA01 met package at Millstone and the GSOS met package at Westford.

This is a test of the accuracy of using an alternative met package at Westford.

3. Data

Get pressure data for 2005 DOY 208 for SA01 from the Suominet web page:

Suominet data

```
Go to http://www.suominet.ucar.edu
      database interface
      select SA01, fill in date
          (e.g. start 2005 208 and stop 2005 209)
      select P, ZTD, T, RH, ZWD
      submit
      show data
      click here to see data
      under File select Save As and give file name
           e.g. /users5/aen/SA01
```

Get pressure data for 2005 DOY 208 for WES2 from the CDDIS web page:

GSOS data for WES2

```
fttp://cddis.gsfc.nasa.gov/gps/data/daily/2005/208/05m
      get file wes22080.05m
```

Create matlab file c:\aa\met_sensors\wes2_pressure_comparison.m to plot GSOS (every five minutes) and SA01 data (every thirty minutes). Apply height difference correction using nominal lapse rate of -6.5 K/km. Get heights of both antennas from Teresa van Hove of Suominet to be able to use a consistent set.

The GSOS data seem to be offset in time by about +1 hr 30 minutes. Offset the GSOS values by -1.5 hours and plot to confirm. Get data from yoda (met instruments at Haystack antenna 1.5 km away) to see which is correct: SA01 and yoda agree, indicating that the time tags for the GSOS data are in error. (A rough guess for the uncertainty in the height correction for yoda is ~0.1m. See dotm file for calculations.)

Use measured height differences for GSOS to WES2 and for the SA01 met instruments relative to SA01.

➔ Met data for SA01 are already adjusted to the position of the antenna!!! I discovered this after many e-mails to Teresa van Hove!!!

```
GSOS – WES2 = -10.2 m (M. Poirier drawing)
met(SA01) – SA01 = -11.777 m (Frank Lind e-mail; sigma < 1m)

For future reference, here is the pressure correction for
Suominet data to Westford intersection of axes (IOA):
% heights from Theresa van Hove using xyz2gd (m)
ht_s = 113.166;   % height of SA01
ht_w =  86.029;  % height of wes2
% wes2_minus_w_vlbi = -1.748 m
% So height difference
% sa01 - vlbi = ht_s -ht_w + wes2_minus_vlbi
%             = 113.166 - 86.029 - 1.748
%             = 25.389 m
%          (met sensor above antenna)
% so pressure correction from SA01 to Westford IOA is 25.4/8 =
% +3.2 hPa
```

Temperatures are shown in Figure 1 with time offset of -1.5 hours for GSOS. Pressures without time offset shown in Figure 2. Pressures with time offset of -1.5 hours and adjusted to height of WES2 are shown in Figure 3.

Interpolate GSOS pressure (offset -1.5 hr) to the time of the SA01 data

```
mean SA01-GSOS    = 0.015 hPa
median SA01-GSOS  = 0.05 hPa
std dev SA01-GSOS = 0.20 hPa
```

Interpolate GSOS pressure (offset -1.5 hr) to the time of the yoda data

```
mean YODA-GSOS    = -0.38 hPa
median YODA-GSOS  = -0.39 hPa
```

```
std dev YODA-GSOS =  0.20 hPa
```

So the mean of the difference suominet pressure minus GSOS pressure, after correction to position of WES2, AND AFTER CORRECTION FOR TIME OFFSET of -1.5 hours, is less than 0.1 hPa on this day. I used the yoda data only to determine which data set had the time offset. I do not know what the accuracy of the yoda pressures should be.

4. Conclusion

The Suominet data are satisfactory for use as an alternative to the GSOS data for WES2 and for Westford VLBI with a bias of less than 0.1 hPa and a standard deviation of 0.2 hPa.

I thank Teresa van Hove for providing additional information and for clarifying many things about the Suominet data.

5. Figures

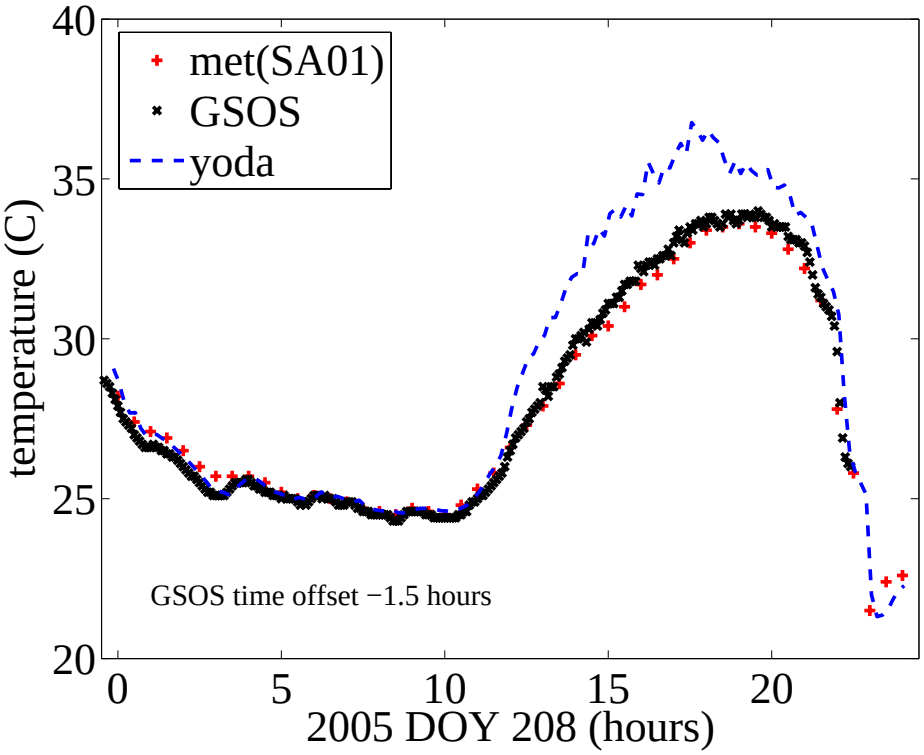

Figure 1. Temperatures from GSOS, Suominet, and yoda met sensors. GSOS time corrected by -1.5 hours.

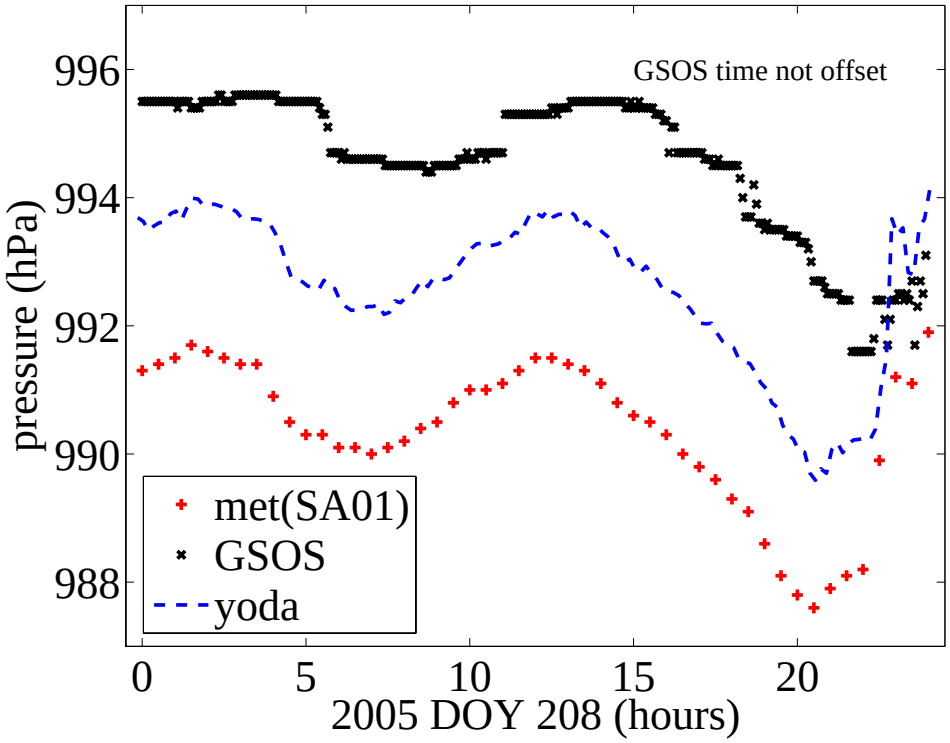

Figure 2. Pressures from GSOS, Suominet, and yoda met sensors. GSOS time not corrected

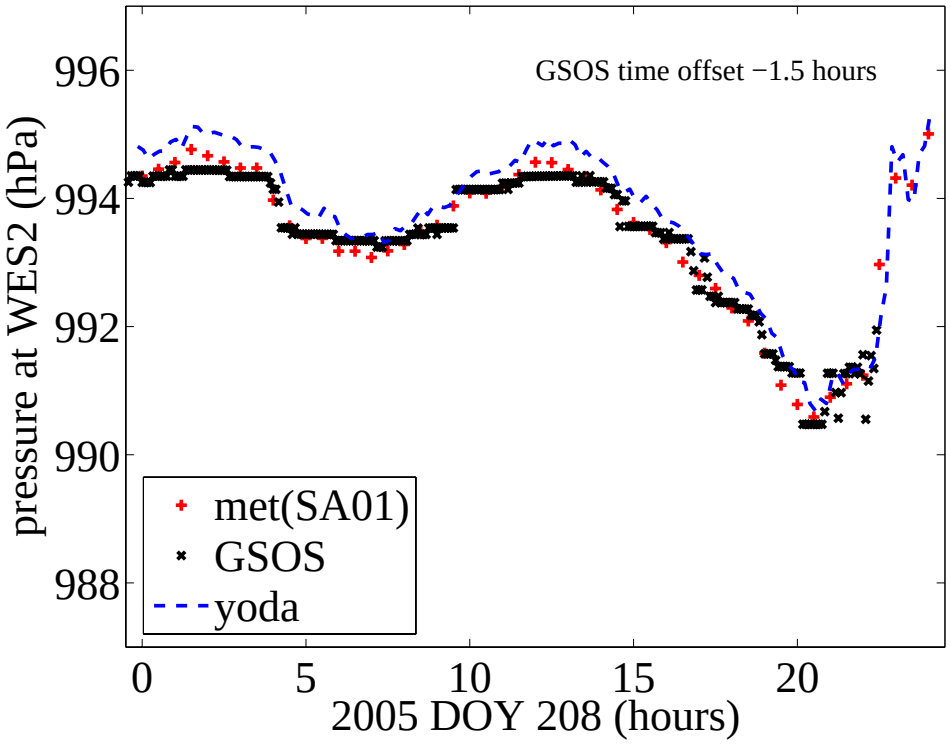

Figure 3. Pressures from GSOS, Suominet, and yoda met sensors adjusted to height of WES2. GSOS time corrected by -1.5 hours. Suominet time not corrected.